

What is claimed is:

1. An apparatus for delivering a predetermined volume of liquid to a plurality of delivery sites, which comprises:

a body defining a liquid pressure chamber and a pneumatic pressure chamber, said chambers separated by a flexible member;

a plurality of liquid channels in said body connecting said liquid pressure chamber to a plurality of delivery ports to deliver liquid to said delivery sites;

a plurality of valves associated with said liquid channels, each channel having at least one valve;

said flexible member exerting pressure on a liquid when said liquid pressure chamber is filled with said liquid and pneumatic pressure is exerted on said flexible member through said pneumatic pressure chamber; and

a prescribed volume of liquid is delivered through said channels to and out of said delivery ports when said valves are opened.

2. The delivery apparatus as recited in claim 1, wherein said body includes a heart-type valve pump and a fluid delivery manifold with an elongated port communicating with said plurality of liquid channels.

3. The delivery apparatus as recited in claim 2, wherein said fluid delivery manifold comprises a plurality of manifold modules assembled in side-by-side relation.

4. The delivery apparatus as recited in claim 1, wherein said liquid pressure chamber and said pneumatic pressure chamber are elongated chambers with mating elongated openings separated by said flexible member, and said plurality of liquid channels are connected directly to said liquid pressure chamber through a manifold which also includes said plurality of delivery ports.

5. The delivery apparatus as recited in claim 4, wherein said pneumatic pressure chamber is a low pressure chamber, said plurality of delivery valves are pneumatic valves, and a second pneumatic pressure chamber exerts a high pressure on said delivery valves to maintain said delivery valves in a closed condition except when delivering liquid through said liquid channels to said delivery ports.

6. The delivery apparatus as recited in claim 5, wherein the volume of liquid delivered to said delivery ports is controlled by the amount of time the pneumatic delivery valves are opened by release of high pressure from the high pressure pneumatic chamber.

7. The delivery apparatus as recited in claim 5, wherein said low pressure pneumatic pressure chamber exerts a

head pressure on said liquid in said liquid pressure chamber when air pressure is exerted in said low pressure chamber to cause liquid to flow through said liquid channels when said high pressure is released from said pneumatic delivery valves.

8. The delivery apparatus as recited in claim 1, wherein said delivery ports are formed integrally with said body and said liquid channels are continuous in said body to an outlet of said delivery ports.

9. The delivery apparatus as recited in claim 1, and further comprising a pair of valves in each liquid channel, one on each side of said liquid pressure chamber, and said prescribed volume of liquid is delivered through said channels to and out of said delivery ports when one said valve is closed and the other said valve is opened.

10. The fluid delivery apparatus as recited in claim 1, wherein said apparatus is reversible for delivering a prescribed volume of liquid out of said delivery ports and for withdrawing a prescribed volume of liquid into said delivery ports.

11. An apparatus for delivering a predetermined volume of liquid to a plurality of delivery sites, which comprises:
a body defining a plurality of liquid channels each connected to a separate delivery port;

fluid dosage chambers associated with each liquid channel and having a specified volume to measure a prescribed volume of liquid to be delivered out of each delivery port, said volume of liquid determined by said specified fluid dosage chamber volume;

said liquid channels each having a first valve in advance of said fluid dosage chamber to control liquid into said chamber when a vacuum is drawn in said fluid dosage chamber; and

said liquid channels each having a second valve between said fluid dosage chamber and said delivery port to control liquid out of said fluid dosage chamber and to said delivery port when pressure is applied to liquid in said fluid dosage chamber.

12. The delivery apparatus as recited in claim 11, wherein said body defines a reservoir connected to said liquid channels for delivering liquid through said channels to said fluid dosage chamber when said first valve is open.

13. The delivery apparatus as recited in claim 11, and further comprising a flexible diaphragm associated with said fluid dosage chambers which creates said vacuum to draw said prescribed volume of liquid into said fluid dosage chamber when said first valve is open and creates said pressure on said prescribed volume of liquid in said fluid dosage chamber when said second valve is open.

14. The delivery apparatus as recited in claim 13, wherein said second valve is closed when said prescribed volume of liquid is drawn into said fluid dosage chamber and said first valve is closed when said prescribed volume of liquid is pressured out of said fluid dosage chamber.

15. The delivery apparatus as recited in claim 11, wherein said apparatus is reversible to draw liquid out of multiple receptacles by drawing a vacuum in said fluid dosage chambers when said second valves are open and said first valves are closed.

16. The delivery apparatus as recited in claim 11, wherein said liquid channels are generally vertical and said first valves, said fluid dosage chambers and said second valves are spaced generally vertically in said body.

17. The delivery apparatus as recited in claim 11, wherein said apparatus is associated with an egg injection machine and delivers a prescribed volume of vaccine uniformly to a plurality of injection needles mounted in said machine, said liquid channels each associated with a single needle, for injection into eggs on said machine.

18. A method for delivering a predetermined volume of liquid to a plurality of delivery sites through a plurality of delivery ports at outer ends of corresponding liquid channels, said method comprising:

drawing a prescribed volume of liquid into a plurality of fluid dosage chambers each associated with a single liquid channel by creating a vacuum in said fluid dosage chambers while a first valve in each said liquid channel in advance of said fluid dosage chambers is open and a second valve in each said liquid channel after said fluid dosage chamber is closed, said prescribed volume of liquid into said fluid dosage chamber being determined by a volume of said fluid dosage chamber;

closing said first valves and opening said second valves; and

delivering said prescribed volume of liquid from each said fluid dosage chambers toward said delivery ports by pressurizing said liquid volume in said fluid dosage chambers while said first valves are closed and said second valves are open.

19. The method as recited in claim 18, wherein said vacuum and said pressure are created by a flexible diaphragm moving in said fluid dosage chambers between a vacuum forming condition and a pressure forming condition.

20. The method as recited in claim 18, wherein the method is reversible by drawing a vacuum in said fluid dosage chambers when said first valves are closed and said second valves are open and creating said pressure in said fluid dosage chambers

when said first valves are open and said second valves are closed.